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ABSTRACT

Finger temperature was recorded bilaterally from 29 right handed test anxious females while they listened to a tape describing test taking situations. Subjects also completed the A-State and A-Trait anxiety inventories, the Test Anxiety Inventory, the Irrational Beliefs Test, and the Differential Personality Questionnaire. A significant temperature decrease in response to the test anxiety tape was observed on the left but not the right hand. A difference score reflecting greater decrease in left than right hand temperature was significantly correlated with five trait variables, indicating a relatively greater left hand decrease in subjects with higher trait anxiety, more irrational beliefs, a poorer feeling of well being, being more reactive to stress and less assertive in social situation. These results support a greater role of the right hemisphere in autonomic response to stressful situations. (Author/RD)

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Asymmetric finger temperature response to test anxiety imagery

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Abstract

Finger temperature was recorded bilaterally from 29 right handed test anxious females while they listened to a tape describing test taking situations. Subjects also completed the A-State and A-Trait anxiety inventories (Spielberger, Gorsuch and Lushene, 1970), the Test Anxiety Inventory (Spielberger, Taylor, Gonzalez, Bedel and Anton, 1977), the Irrational Beliefs Test (Goldfried and Sobocinski, 1975) and the Differential Personality Questionnaire (Tellegen, Note 3). A significant (.05) temperature decrease in response to the test anxiety tape was observed on the left but not the right hand. A difference score reflecting greater decrease in left than right hand temperature was significantly correlated with 5 trait variables, indicating a relatively greater left hand decrease in subjects with higher trait anxiety, more irrational beliefs, a poorer feeling of well being, being more reactive to stress and less assertive in social situation. These results support a greater role of the right hemisphere in autonomic response to stressful situations.

Descriptors: Finger temperature, Test Anxiety, Bilateral differences, Hemispheric differences, Personality correlates.

Running Title:

Asymmetric finger temperature response

ASYMMETRIC FINGER TEMPERATURE RESPONSE TO TEST ANXIETY IMAGERY

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Bilateral differences in electrodermal and vasomotor activity recorded from the two hands have frequently been observed. (Varni, Doerr, and Franklin, 1971; Bull and Gale, 1975). However, only recently have attempts been made to understand these differences. Myslobodsky and Rattok (1975, 1977) reported that electrodermal activity was greater on the left hand during the processing of spatial information and on the right hand while processing verbal information, suggesting that differential hemisphere involvement may have accounted for these results. However, Ketterer and Smith (1977) failed to replicate this finding. Davidson, Schwartz and Weinberger (Note 1) reported increased electrodermal activity from the left hand while answering emotionally-laden questions, a finding which is consistent with evidence implicating the right hemisphere in emotional responding (Gainotti, 1972; Carmon and Nachshon, 1973; Tucker, Roth, Arneson, and Buckingham, 1977).

In an earlier investigation (Papsdorf, Ghannam, and Kuzsma, Note 2) we observed a significant drop in digit temperature on the left side but not on the right in subjects listening to a tape of progressively stressful test-taking imagery. Decreases in skin temperature primarily reflect peripheral vasoconstriction (Surwit, 1973) and frequently accompany emotional arousal (Boudewyns, 1976). The present study was designed to replicate our earlier findings using

a population consisting of right-handed females entering a test-anxiety alleviation program. This was a clinical group seeking treatment who were presented with a relevant stressor (i.e., a tape of progressive test-taking sequences). A second purpose of this study was to examine the relationship between digit temperature response and several personality and anxiety variables.

METHOD

Subjects

Subjects were 29 females entering a test anxiety alleviation program. Handedness scores were determined by the use of the Edinburgh Handedness Inventory (Oldfield, 1971) and all scores were in the right-handed direction.

Apparatus

Temperatures were recorded using Yellow Springs Thermistors (Model #709) with the signal amplified through Coulbourne Temperature Bio-feedback units. Average temperatures (over 30 seconds) were computed by an Autogen 5600 Microprocessor and printed on paper tape.

Procedure

The data reported here are part of a larger research project involving the assessment and alleviation of test anxiety. Subjects were first assessed for reflective gaze preference (Gur and Gur, 1974) in a separate room where they completed the Edinburgh Handedness Inventory (EHI), A-State and A-Trait anxiety inventories (Spielberger, Gorsuch, and Lushene, 1970) and the Test Anxiety Inventory (TAI) (Spielberger, Taylor, Gonzalez, Bedell, and Anton, 1977). Subjects then entered a temperature-controlled recording room (22°C) and reclined in a padded chair. Thermistors were attached to the volar

surface of the distal phalange on the middle digit of each hand. With their eyes closed, subjects listened to a 5-minute tape of progressive relaxation and actively participated in the exercises. Immediately following this, each subject heard a second 8-minute tape in which they were instructed to visualize themselves in a series of situations relating to test-taking. Following the anxiety tape all subjects were asked to rate how stressed they felt while listening to the tape on a scale of 1, not at all; 2, somewhat; 3, moderately; and 4, extremely. Similar ratings were obtained of how realistic the testing situation described was, and how vividly they were able to imagine themselves in the scenes. The subjects were then taken to another room and were administered the Irrational Beliefs Test (IBT) (Goldfried and Sobocinski, 1975) and the Differential Personality Questionnaire (DPQ) (Telegen, Note 3).

RESULTS

Mean digit temperature recorded initially and at the end of the anxiety tape are presented in Table 1. The average temperature drop in the left hand (1.1°C) was significant, $t(27) = 2.83$ (the .05 level of significance used throughout), but the average

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INSERT TABLE 1 ABOUT HERE

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drop in right-hand temperature (.7°C) was not, $t(27) = 1.90$. The difference in the drops (.4°C) was not significant.

On the basis of the stress ratings, the subjects were divided

into two groups: a "More Stressed" group (n=15) comprised of those subjects rating the tape as "moderately" or "extremely" stressful, and a "Less Stressed" group (n=14) comprised of those rating the tape as "not at all" or "somewhat" stressful. The decreases in hand temperature were analyzed separately for these two groups (Table 1). The More Stressed subjects showed a significant decrease in temperature for the left hand, $\bar{x}$ = 1.78°C, t(14) = 3.51, but not for the right, $\bar{x}$ = 1.08°C, t(14) = 1.80. The Less Stressed group did not show a significant drop in either the right, $\bar{x}$ = .46°C, t(13) = .82, or the left, $\bar{x}$ = .46°C, t(13) = .66, hand temperature. The difference between the drops for the two hands was significant (one tailed) for the More Stressed subjects, $\bar{x}$ = .70°C, t(14) = 1.78, with the left hand temperature dropping more.

Correlations were calculated between the temperature drops and the TAI, A-State, A-Trait, and IBT (table 2). The difference in the drops correlated significantly with trait anxiety and the IBT, indicating

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INSERT TABLE 2 ABOUT HERE

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that the left hand decreased more than the right in subjects reporting high trait anxiety and many irrational beliefs. This measure also correlated with three DPQ subscales: Well-Being (r = -.42), Stress (r = .47) and Social Potency (r = .38). The right hand temperature drop did not correlate with any of the variables; and the left hand drop only correlated with the Impulsiveness scale of the DPQ (r = .37).

The stress ratings (Table 2) indicate that the tape was rated as more stressful by subjects who had higher test anxiety, worried more about tests, and who reported more state anxiety before

listening to the tape. The stress ratings also correlated with the rating of how realistic the tape was ($r = .49$), but not with ratings of how well they were able to visualize themselves in the testing situation described on the tape ($r = .09$).

DISCUSSION

These results are consistent with our previous observation that in response to a test anxiety hierarchy tape, decreases in digit temperature are expressed more on the left hand than on the right hand. This difference was greatest for subjects who reported the tape as more stressful. Results from correlational analysis reveal further evidence for greater left hand reactivity to stress. The difference between the drops in temperature of the two fingers correlated significantly with five trait variables. That is, a relatively greater left hand temperature drop was exhibited by subjects characterized by higher trait anxiety, more irrational beliefs, a poorer feeling of well-being, being more reactive to stress and less assertive in social situations. With respect to the uni-lateral digit temperature decreases, neither the right nor left hand temperature drops in themselves yielded a similar pattern of correlations. It is of particular interest to note that decreases in left digit temperature did not correlate with the five variables associated with differential digit decreases. Apparently it is necessary to eliminate the extraneous influences which affect digit temperature bilaterally in order to obtain a sensitive measure of autonomic reactivity. Therefore it seems wise for experimenters recording bilateral autonomic responses to incorporate a differential change score (i.e., left minus right)

as an alternate measure of reactivity.

Two mechanisms have been proposed which might explain the greater left side reactivity to stress. Kinsbourne (1972), in attempting to explain why reflective thought is often accompanied by head and eye movements in a direction contralateral to the active hemisphere, suggested that activation in one area of a hemisphere might spread to activate other centers in the same hemisphere, e.g., motor areas. Assuming the right hemisphere is primarily involved in the emotional response to stress (e.g., Tucker et al., 1977), Kinsbourne's interpretation might be extended to include activation spreading (perhaps subcortically) to centers controlling autonomic activity. A second possible mechanism was presented by Galin (1974), who suggested that lateralized autonomic activity might reflect the hemispheres being differentially "affectively aroused" by the stimulus. According to this model, the test anxiety tape might be perceived as stressful by the right hemisphere, but less so by the left hemisphere, thereby resulting in asymmetrical autonomic responding.

A somewhat unexpected finding was that the rating of how stressful the tape was correlated with a different set of variables than those related to the (lateralized) temperature response. The variables correlating with the stress rating -- high test anxiety, tendency to worry more about tests, high state anxiety before listening to the tape, and finding the tape to be realistic, are all state or situation specific. These variables likely played a causal role in determining the stress experience elicited by the anxiety tape (Schachter and

Singer, 1962). Similarly, the trait variables which correlated with the differential temperature response to stress likely played a causal role in determining that autonomic response. Taking these two interpretations together yields a picture of subjective stress experience and autonomic activation as separate dimensions of the total stress reaction with each factor primarily under the control of a different set of variables: the subjective response determined by state and situation specific variables; the autonomic response determined by relatively enduring traits. This conceptualization may shed light on the reason for the generally reported finding of low correlations between self-reports and autonomic responses to stress (e.g., Hodges, 1976).

NOTES

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2. Papsdorf, J.D., Ghannam, J., and Kuzsma, T. Lateral eye movements: Anxiety correlates of reflective gaze preference. Paper submitted.
3. Tellegen, A. The Differential Personality Questionnaire Manual. In Preparation. Available from Auke Tellegen, University of Minnesota.

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TABLE 1

MEAN (AND STANDARD DEVIATION) DIGIT TEMPERATURES (°C)
FOR EACH HAND RECORDED INITIALLY AND AT THE
END OF THE ANXIETY TAPE

	Initial		End of Anxiety Tape	
	Right Hand	Left Hand	Right Hand	Left Hand
All Subjects (n=29)	27.5 (3.47)	27.0 (3.15)	26.8 (4.18)	25.9 (3.56)
More Stressed (n=15)	27.0 (2.27)	26.7 (1.92)	25.9 (2.44)	24.9 (1.87)
Less Stressed (n=14)	28.1 (4.46)	27.3 (4.16)	27.7 (5.52)	27.0 (4.68)

TABLE 2

CORRELATIONS OF THE TEMPERATURE DROPS, THE DIFFERENCE IN THE DROPS (LEFT MINUS RIGHT) AND THE STRESS RATINGS WITH THE ANXIETY MEASURES AND THE IBT

	Drop in Left Temp.	Drop in Right Temp.	Difference in the Drops	Stress Rating
TAI	.16	.21	.05	.40*
Worry	.35	.24	.12	.38*
Emotionality	.18	.13	.05	.34
A State	.18	.04	.18	.39*
A Trait	.23	-.06	.40*	.15
I.B.T.	.15	-.20	.47*	-.16

*P<.05